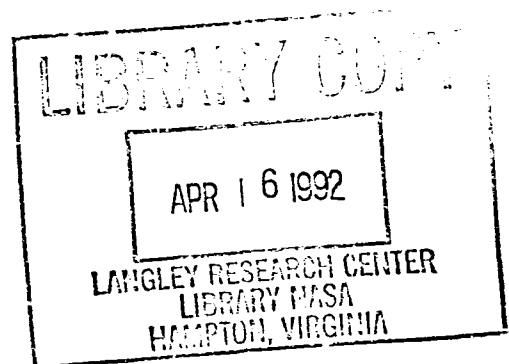


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## Abstract

Scientific and Technical Information (STI) is a valuable resource which represents the results of large investments in research and development (R&D) and the expertise of a nation. For more than four decades, NASA and its predecessor organizations have developed and managed the preeminent aerospace information system. NASA obtains STI materials from internal sources, through its international and national exchange relationships and by purchase. These materials are continually added to the NASA Aerospace Database (NAD) thereby increasing its comprehensiveness and value. The NAD is the de facto international aerospace database but is still not all encompassing of the literature. A number of changes have occurred in the aerospace industry and in information technology capabilities which make it feasible and desirable to focus on creating a more comprehensive and truly international aerospace database (IAD). Science and technology projects are becoming more and more international and interdisciplinary. Other parts of the world, notably Europe, are increasingly powerful players in the aerospace business. This change has led to the development of various aerospace information initiatives in other countries. With scarce resources in all areas of government and industry, the NASA STI Program is reviewing its current acquisition and exchange practices and policies to factor in the changing requirements and new opportunities within the international community. This paper reviews current NASA goals and activities with a view toward developing a scenario for establishing an IAD, maintaining compatibility among national aerospace information systems, eliminating duplication of effort, and sharing resources through international cooperation wherever possible.

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## Introduction

The history of international aerospace information system development has paralleled that of national aerospace research and development (R&D) programs. The U.S., a major and early entrant into aerospace R&D, created a national focus in the National Advisory Committee on Aeronautics (NACA) in 1915 when the early library system made extensive efforts to acquire documents from worldwide sources that related to NACA programs. NACA was followed by the creation of the National Aeronautics and Space Administration (NASA) in 1958. From NASA's conception the need for and role of a centralized scientific and technical information system was recognized. NASA's enabling legislation requires NASA to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof." The international nature of the mission was also recognized in the directive for NASA to conduct its activities "so as to continue to contribute materially to ... cooperation by the United States with other nations and groups of nations in work pursuant to the Act and in the peaceful application of the results thereof." The result of this major U.S. R&D mission and the creation of an integral scientific and technical information (STI) mission led to the early commitment and continued development of a NASA STI Program and a NASA aerospace database consisting of world-wide information.

As the aerospace programs of other nations grew, particularly in Europe with the creation of the European Space Agency (ESA), NASA found a natural partner for cooperation in both its technical and its information programs. NASA expanded database input to include resources provided by ESA. More recently in Europe, and consistent with joint R&D programs and a view toward a United Europe, we have seen the emergence of a European Aerospace Database (EAD) concept. Today, in addition to

the ESA programs, the development of aeronautics and astronautics in individual nations has also led to initiatives (in various degrees of development) of national databases such as the German Aeronautics and Astronautics Database - Deutsche Luft-und Raumfahrt Datenbank (DELURA) initiative and the for a Japanese aerospace database called the Japanese Aerospace Information Reference System (AIRS).

Considering the advances that have been made in information technology, the increased international participation in the aerospace field and the realities of scarce resources for every nation, the time seems right to rethink strategies for cooperation and international resource sharing. A vital part of this thinking involves participating in dialogues on the subject with current international exchange partners. The feedback the NASA STI Program has been receiving, including the statements made at the European Forum on Information and Documentation held in Strasbourg in January 1990 by representatives of a major German exchange partner, clearly indicates that there is a desire for international cooperation and a need for program flexibility and change. NASA, in cooperation with ESA, is undertaking a major survey to explore exactly what the issues and opportunities are for the future of information exchange.

This paper poses some ideas about where to go from here. It raises for consideration the unification of international aerospace database efforts toward a cooperative international aerospace database initiative that can optimize the cost/benefit equation for all participants.

### The NASA Aerospace Database

The NASA Aerospace Database contains bibliographic citations to international aerospace literature. This database contains citations referencing the results of NASA funded research and development activities plus material acquired through both exchange agreements and purchase arrangements. NASA has exchange agreements with other U.S. organizations such as the Defense Technical Information Center (DTIC) and the Department of Energy, Office of Scientific and Technical Information (DOE/OSTI). International

exchange agreements consisting of Bilateral Document exchanges (see Figure 1), NASA/ European Space Agency (ESA) Tripartite exchanges and National level agreements are in place.

<b>Current NASA Bilateral Document Exchanges</b>			
<ul style="list-style-type: none"> <li>• 43 Countries</li> <li>• 220 Exchange Agreements</li> <li>• Up to 2,500 Technical Reports/Published Items Accessioned Per Year (Average)</li> <li>• Top 20 Countries with Number of Participating Institutions:</li> </ul>			
Australia	7	Japan	24
Belgium	3	Netherlands	12
Canada	13	New Zealand	4
Denmark	7	Norway	3
Finland	4	South Africa	4
France	14	Spain	4
Germany	14	Sweden	5
India	10	Switzerland	4
Israel	6	United Kingdom	39
Italy	8	USSR	5

*Fig. 1. Bilateral document exchange summary.*

These relationships and their associated policy and technological exchange protocols have evolved over time. Figure 2 on the following page depicts the historical development of these relationships. NASA purchases additional materials in critical aerospace areas which are not available through NASA internal or exchange channels.

Today, the NAD contains 2,252,000 research summaries covering 1962 to the present. Approximately 27 percent of the NAD is made up of R&D results originally published outside of the U.S. In fact, this percentage is increasing. In 1990 it was 36 percent (25,000 out of 69,000 records). This is a result of better acquisition processes as well as an increased proportion of the knowledge base being developed abroad. Figure 3 provides a further breakdown of these numbers by major geographic areas of interest. Of the foreign material, more than 10 percent of the original documents are written in languages other than English. The NAD has English language summaries of all of these research publications.

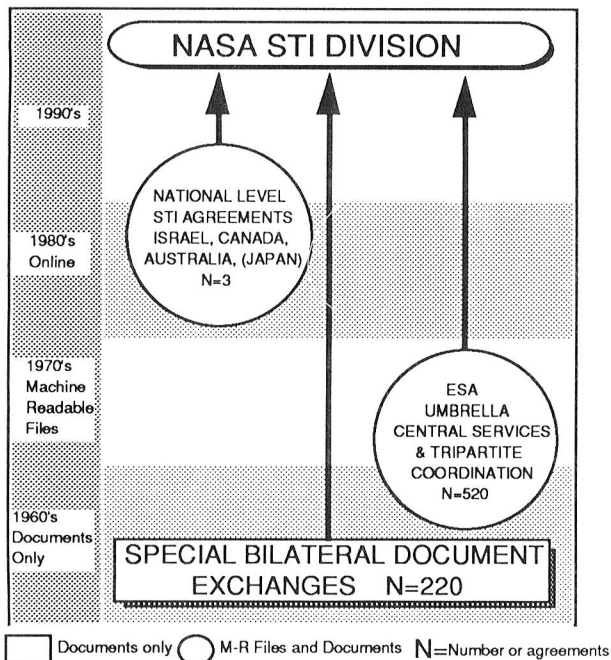


Fig. 2. Historical development of international exchange relationships.

The NAD is the premier aerospace database in the world and has served as the de facto international aerospace database.

#### Need for Change

The NAD was created and is maintained for a single purpose - to advance knowledge by providing access to an organized repository of aerospace information. Having the "largest" or the "best" or the "easiest to use" database means nothing if the knowledge worker who utilizes the resource is not satisfied. The NASA STI Program has been surveying its world-wide customer base to assess satisfaction levels and areas in need of improvement. Although we are only half way through this process, the customers who have responded thus far appear to have common concerns. The major thrusts of the NASA internal customers are:

- The NAD is not complete
  - subject coverage needs to be expanded
  - more coverage of non-US literature is needed
  - the number of items acquired each year needs to increase
  - more types of information need to be

included (numeric, factual, multimedia, etc.)

- The full text of the document is needed rapidly
  - current system of on-line bibliographic citations and delivery delays for the document is not acceptable
  - customers want to be able to access the full text from the desktop/office
- The retrieval system needs to be improved
  - system should be intuitive to use
  - precision retrieval should be possible
- A virtual database is acceptable

All of these issues fit into the theme of supporting the decision making process. If a researcher needs information to determine how to structure a project, what direction they should go, etc., they want the decision supporting information regardless of the country of origin. They need access to interdisciplinary information - not just to their own specialty - and they need all the information rapidly. Improved retrieval systems which are "intuitive" to use will allow researchers to embed the information seeking and delivery tools that we develop into their daily decision making process.

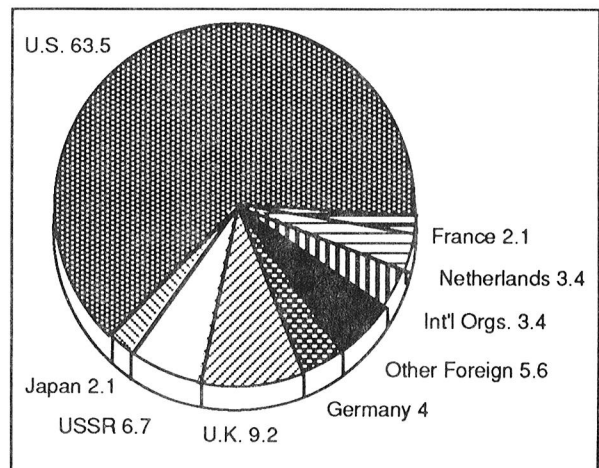


Fig. 3. Percent of R&D summaries in the NASA Aerospace Database, by country for 1990 input.

Interestingly, the international exchange partners with whom we have held meetings on this subject express similar concerns. Key items include:

- The NAD scope is too limited
- The NAD acceptance criteria is too restrictive
- NAD access policies (who & how) are too restrictive
- NAD format requirements need to be rethought

Change is definitely needed in the view of the users.

### NASA/ESA Tripartite Survey

NASA and ESA jointly surveyed Tripartite exchange partners to determine their satisfaction level with current procedures. NASA/ESA have official tripartite agreements with 526 institutions in 16 countries which include the 13 European ESA member states (Austria, Belgium, Denmark, France, Germany, Ireland, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom) plus Finland, Portugal and Morocco. The basis of the tripartite arrangement is that an institution receives the rights to access the NAD commercially via ESA's Information Retrieval System (ESA/IRS) in exchange for submitting technical documents for inclusion in the NAD. The rate of exchange as established in the agreement has been one search hour for each technical report. ESA abstracts and indexes the reports received from these organizations in English and in the NASA format as part of the exchange agreement.

Questionnaires were sent to all of these organizations to determine their views on the current exchange arrangements and to solicit ideas for opportunities to improve or expand cooperative relationships. Questionnaires from 13 countries have been returned to date. The responses give indications of values associated with the exchange and point out some opportunities for improving the system.

Many of the participating institutions have perpetuated the relationship because of the value of on-line access to the NAD. It is apparent from the responses that the

relationship has not been viewed as an active partnership, but rather a simple marketplace exchange relationship. This was the view encouraged by NASA policy. In fact, on many of the questions about the program where a checklist of responses was provided, the "don't know" category received large numbers. On the question whether, in general, the respondent found the program to be a valuable one, almost half of the respondents "didn't know." Of those that did, however, all but two found the program valuable. Although the earlier lack of European involvement was consistent with the requirement of the NASA approach at the time, today, more active international partnerships and commitment can be of great benefit to all parties involved.

Most respondents felt that all of their institutions' R&D reports were not comprehensively included in the NAD. However, the majority felt that items did appear in the NAD in a timely manner. An overwhelming majority of respondents felt that the current subject scope of the NAD adequately covered their needs in aerospace science and technology. For those that disagreed, the following subjects were suggested as missing: airports' air traffic, regional and operational air traffic problems, military aircraft equipment, history of aeronautics/astronautics, air transport economics and politics, airline management, ecology (not only environmental pollution), and national and international space policy. The emphasis on requirements for operational aviation data is interesting and may lead to some exploratory discussions on the relationship between NASA R&D information and that more closely associated with the Federal Aviation Administration.

A number of questions were designed to solicit ideas about how to improve the program and promote more international involvement and participation. Some of the specific questions were based on ideas that had already been suggested by participating organizations through personal contact. In answer to a question regarding the creation of a Users' Council, the data indicated considerable interest in creating



one, with the highest interest at the European level. Both the international and national level were of some but less interest.

There was considerable interest in developing a common and comprehensive International Aerospace Database. Thoughts on how to develop such a system included the following:

- Combine the NASA and ESA (EAD) files
- Increase coverage of the Soviet Union and Japan
- Encourage cooperation with national information centers

Throughout the answers to open ended questions, respondents made suggestions about expanding the international coverage outside of Europe. Of greatest interest was increased coverage of Soviet and Japanese literature.

In addition to suggestions to improve the bibliographic coverage, a number of organizations suggested sharing other types of STI. The types of STI suggested for sharing included databanks, especially those with experimental data; factual databases; research in progress, directories, material property databases; engineering drawings; and even "databases for molecular properties for radiative transfer in atmospheres."

#### Impetus for Improving International Cooperation

It is apparent from all the sources contacted thus far that there is a need to change current practices. Technological, economical and policy considerations make changing these practices a necessary and desirable step to improve international cooperation in STI. First, some of the technological barriers which resulted in restrictive policies in the past have been removed. Storage costs have decreased tremendously, retrieval capabilities have improved and networking solutions are widely available. It is no longer necessary to implement policies to discard potentially useful information because it is too expensive to keep in a costly centralized system or because it will "clutter" search results with irrelevant information. More importantly, we in the information service sector are facing a potentially major paradigm shift in the way

information is produced, managed and used. There is an opportunity through international cooperation to develop a more unified approach to how our services accommodate these changes which will aid all of our individual user communities.

On the economic side, budget constraints which we are all facing make cost leveraging and sharing results highly desirable. If we share the costs to acquire and process the world-wide aerospace literature we will all benefit by having more information available for our user communities. We can then spend budget allocations on processing unique information, expanding acquisitions, adding value to our current abstracting and indexing process, or adding new types of information such as research in progress, numeric data or multimedia information to the exchange relationship.

Cost sharing in the area of the development and operation of our information systems themselves is another possibility. Can we share in the development of the next generation of systems? Can we share network solutions? Cooperation in information technology development will likely lead to systems solutions far more advanced and sophisticated than any which could be financially supported by a single institution.

Networks and the internationalization of science will increasingly eliminate boundaries to international information flow. However, we must develop new policies to reap full benefit from the new opportunities. Having compatible policies and standards for the structure and content of aerospace databases or information would add greatly to the utility of the information that these networks can deliver. Existing NASA STI policies (such as one document for one hour of search time) and restrictive scope definitions no longer have positive value in this environment and act as disincentives to international cooperation.

#### Recommendations for International Aerospace Database (IAD) Cooperation

Evaluation of current reactions to the NAD indicate that although the NAD may be the most comprehensive international aerospace

database, it is by no means complete. Our goal at NASA is to get closer and closer to having a complete database that satisfies the information needs of our user base. The most practical way to achieve this is to work with other organizations who share this goal and develop cooperative strategies to realize it. As a first step we must establish an advisory group made up of representatives from interested organizations. This advisory group should first develop a comprehensive list of IAD issues to be addressed. These issues might include:

- How can we take the exchange relationships we have today and make them the base for a more cooperative international effort?
  - What types of agreements and relationships encourage involvement?
  - Should a formal group be established to set policy for an IAD?
  - Should user meetings be held on a regular basis?
- How do we make the bibliographic database more comprehensive and timely?
  - How do we motivate information producers to provide input?
  - Are countries responsible for providing their own national input?
  - How do we cover parts of the world not participating in the effort?
- How do we update the scope, the thesaurus and other standards?
  - Should we appoint a team of experts?
  - Would a survey method be appropriate?
- How do we make the database available?
  - Who is eligible for access?
  - What should our pricing strategies be?
  - What is an appropriate network architecture?
- What strategies do we need to go beyond bibliographic cooperation into sharing of other kinds of data and information, including improvements in systems and technology for delivery and management of information?

- How do we reconcile the national need for proprietary aerospace information with participation in an IAD?

- Will nations still maintain national databases?
- How do we insure reciprocity?
- How do we protect intellectual property rights?

We suggest that this advisory group develop a temporary operating structure which could be used to "test and refine" the IAD concept. After a period of test and refinement, the structure would be formalized and institutionalized.

The NASA STI Program is working with its current exchange partners such as ESA to determine if there is enough support for an IAD to set up an advisory group and move forward on this concept. Given enough interest, the effort could begin in 1993, and we would be on our way towards developing a truly international and comprehensive aerospace database.

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